

Harry Kennard 0:19

Hello, and welcome to episode seven of the climate change and health Podcast. I'm Harry Kennard, and this week I chatted with Dr. Catherine Tonne. Catherine is an environmental epidemiologist focusing on the influence of the physical environment on health and health inequalities, especially with respect to air pollution. She is currently Associate Professor at ISGlobal, which is the Barcelona Institute for Global Health. Like her work more generally, our chat focused on air pollution and its health impacts. But we also touched on the broader co-benefits of climate change mitigation. I hope you enjoy the discussion.

I'm delighted to welcome Catherine Tonne to the podcast. Usually, Catherine, we begin with a little background about how you got interested in researching the topic area into which is air quality broadly defined? Could you give us some background about that?

Catherine Tonne 1:24

Well, firstly, thanks so much Harry, for the invitation to be here with you. And so I, I've even I think from when I was a 13 years old, I was interested in environmental issues. And when I started university, I was thinking what was the best discipline to apply to environmental issues, it was thinking about economics. In the end, I ended up studying chemistry. And really my first exposure to working with working on air pollution was while I was in university and a research intern in an atmospheric chemistry lab there. And from there, I think I got more and more interested in sort of what was the main sort of societal impact of air pollution? Why do we care about air pollution, and one of the main justifications is always the public health impacts. So I started to get more interested in the public health side of it. And then went on to do my graduate training in in epidemiology. But it's been a long journey from I think, from a young age, but this sort of taken me full circle from the physical science side to the Health Sciences.

Harry Kennard 2:46

Yeah, you're not the first person on the on the podcast who have gone through that journey. And I have a similar from physics initially, but physics chemistry is, you know, close cousins. That's, that's wonderful. So in terms of sort of helping the the listener understand a little bit about how environmental epidemiology works in terms of air pollution, can you outline some of the sort of global patterns that we see a puzzle regarding where air pollution is worse? I mean, we all have a sort of intuitive understanding, but it'd be good to get a sense of the scientific understanding.

Catherine Tonne 3:22

Yeah, so in many high income countries, like Western Europe and North America, the good news is that air pollution levels outdoors have been going down steadily over the last

several decades. And this has been due mostly to improved technology, and then of pipe emission controls, for example, on vehicles. And so this is obviously good news. In other parts of the world, we see the other, we've seen reverse trends where air quality outdoors is deteriorating. But even in places where it has improved quite considerably, you know, we still have cause for concern in terms of the health effects because, you know, we in recently have been accumulating more evidence of health effects that we can observe at a very low concentrations that you would see in Northern Europe or in places in some parts of the US and in Canada, for example. So there's really as far as we know, from the epidemiology, no safe level of let's say particulate air pollution in particular. So it's and this is what is reflected in the new WHO guidelines where the the new guideline for fine particles is five micrograms per metre cube which is which is really quite low. There very few places where people live on the globe that have air quality levels below the below the new who guideline but this is really consistent with the what we know from the epidemiology we need to get air pollution levels down really low to adequately protect public health. So while it's been going down quite a lot in many high income countries, that's not the case. In many other parts of the world, it's, you know, ambient air quality is a huge public health issue in South Asia, and in Western Africa, for example. And then there's the other part of the story, which is household air pollution. So exposure to combustion byproducts from meeting household energy needs, and this is still a big issue for many parts of the world. In general, the the trends are improving in terms of lower levels of exposure to household air pollution, globally, but there are some, you know, for example, in Sub Saharan Africa, the progress towards getting access to clean, clean cooking, is bent quite slow. So this is, you know, there's which you can say sort of stagnation in in that respect. And I think there's some really great resources out there that are tracking ambient and household air pollution exposure levels globally. And the one that comes to the mind is the state of global air. That's, that comes out from the Health Effects Institute and the Institute for Health Metrics and Evaluation.

Harry Kennard 6:28

Okay. And in terms of just a sort of a sense of, experientially, if that's the word I want, what five micrograms per metre cubed feel that's presumably much lower than the sort of sort of personal sense of being in a polluted environment. So I'm thinking about, you know, the Euston Road in London, near UCL, you've got sort of like, whatever it is, for six lanes of traffic. And that sense that you're sort of really surrounded by a sort of pretty grim cloud of pollutants, presumably, five micrograms is so low that you would you around that you would sort of get the sense of it being sort of like a clean sort of alpine environment. Is that Is that the sort of rough sense of things that really it has to be beyond? What's even perceivably? Bad?

Catherine Tonne 7:21

Oh, yes. Either one. So the WHO guideline of five micrograms is for an annual average. So this is, you know, trying to capture this longer term exposure, which, you know, would be different than when what you expose what you're exposed to when you just cross cross a busy road. So that type of short term exposure, which might be considerably higher, but five micrograms is quite low. So for for fine particles, we have many different sources, some of them are natural sources. So even if we were, you know, to stop all human activity, somehow, we would still have some, you know, a few micrograms per metre cubed concentration in many parts of the world, just from natural sources, but five micrograms is getting close to what would be the natural contribution from two fine particles. So it's very low, and it's essentially incompatible with fossil fuel combustion. So we would I think, is a really important message that to get down to the new WHO guidelines, we really need to stop burning things.

Harry Kennard 8:31

Yes. And that's, and that's across sort of all fossil fuels even I mean, the contribution we hear a lot about the difference between sort of coal and natural gas, but presumably, there's still sort of particular contributions from natural gas, even if they're lower than coal combustion. Is that Is that fair to say?

Catherine Tonne 8:48

Yes, I mean, obviously, call is, is, you know, particularly inefficient. But but it's, it's, but I think that's fair to say. And, you know, we have one of the, let's say, interesting and complex things about fine particles is just that there are so many sources of it. So even, you know, we even if we think about a scenario where we have a fully electrified vehicle fleet, and the electricity is generated from renewable sources, you still have contributions to the particle levels from the brake and tire wear. Right. So, you know, it's not just necessarily combustion related. But that's,

Harry Kennard 9:32

that's interesting to bear in mind, but I suppose it's still worth moving to that world because that's the the breaking tie, whereas is a smaller portion of current sort of contributions from sort of petrol-powered cars.

Catherine Tonne 9:45

Absolutely. We need to move in that direction. But I think from a public health point of view, never lose sight that just replacing the the current system that we have with fossil fuel based motor vehicles to electric vehicles. It can't be the answer because we know that there really large healthcare benefits that can be achieved for getting people out of cars and into

more active forms of transportation. So public transportation, walking and cycling. This is where you get really big public health benefits. You know, while also reducing the greenhouse gas emissions. So, you know, just full conversion to electric vehicles isn't the answer. For many reasons, the brake and tire wear emissions of air pollution is one part of that. But the physical activity benefits from active travel is I think, a big part of that story. And then also just, you know, what kinds of cities and urban public spaces do we want? Do we, you know, do I personally would like to see a future where we have less road traffic injury, congestion, more public space that's used for, you know, the public, not just motor vehicle users?

Harry Kennard 11:02

So okay, that's interesting. So the health impacts of poor quality or from the news, do we? Do you have a sort of an easy sense of how methodologically researchers are able to determine that air pollution is bad just from us? I'm sort of I'm thinking of the sort of battle against the tobacco industry that happened sort of in the mid 20th century, and how much work that took to establish what is a pretty clear causal link.

Catherine Tonne 11:32

So it's, well, just to say something about the the media attention regard related to air pollution first, I mean, firstly, it's, it's great. It's very satisfying to see increasing attention paid towards air pollution. But there's, you know, I asked myself, what took so long, because we've known that this was a major public health problem, we've had very good epidemiological studies, demonstrating that outdoor air pollution was leading to lower life expectancy since the 1990s. So, right, well, it's great to see that, you know, increasing attention now, it's really similar to tobacco, really, what took so long. And I think what's been particularly satisfying in terms of the media attention is really this focus on parts of the world outside of high income countries. And that, you know, we see particularly this time of year, November, we is when you see really high air pollution levels in around Northern India, and the Indo Gangetic plain, you know, that tends to get a lot of media coverage this time of year. And, you know, increasingly also showing some of the evidence that's coming from toxicological studies, so that, you know, we have evidence now that combustion particles don't just get into our lungs, but can be detected in other parts of the body, like in the placenta have been put in, in pregnant women, they have been detected in brain tissue. So I think that is, you know, those, those make really good news stories, because I think it makes it very, it really brings the story home to people, this is not an abstract thing, these particles are getting into your body and damaging, you know, the health of unborn children.

Harry Kennard 13:32

Wow. So there's a sort of sense in which we're much more porous than perhaps we might sort of intuitively imagine.

Catherine Tonne 13:38

Yeah, absolutely. Because there was always this idea that the placenta protects the foetus and, you know, that's the, you know, the foetus should be quite safe. Similar, the brain is protected by the blood brain barrier, but this sort of toxicological evidence is showing that combustion particles can travel through these tissues. And I think that is really disturbing for people. So I think these are really effective media stories, because just to get that kind of engagement that you know, you know, everyone is vulnerable basically, to these combustion products. And I think it also focuses a lot of attention on ultra fine particles, so really small particles. And these are still today unregulated, but I have a particularly important role in Tourette's, in terms of being able to move beyond the lungs into other parts of the body. And in terms of, you know, how do we know air pollution is bad for you? Well, there are different disciplines that are relevant there. I mentioned toxicology so you know, often in toxicology, these are experimental studies that can be done in humans or in human tissue or in animals. You know, this gives us some information about the specific mechanisms, what is it about air pollution that that is damaging for, for particular types of, of tissues and relevant for specific diseases. I'm an epidemiologist, you know, we don't usually do experimental studies in epidemiology for air pollution. There are some randomised control trials that look at for example swapping out traditional biomass based cookstoves for LPG is, is the main where we see the really exciting trial data coming out. So those are experimental studies, but most of what we do is just observing the world as it is, as people go about their their day, their daily lives, some people get exposed more to air pollution than others. And we use that variability to try and link it to see if there's a relationship between higher exposure and higher frequency of, of disease. And so these are typically quite small effects compared to something like active smoking, which we know is really very bad for you, you know, we're looking at, let's say, much more dilute combustion byproducts when we're looking at outdoor air pollution. And so we need really large sample size in our studies to be able to basically identify these associations.

Harry Kennard 16:34

Presumably, if you apply those associations to the sort of the global population, you end up with a pretty significant mortality, sort of contribution from air pollution, even if it's a sort of a more subtle effect than smoking.

Catherine Tonne 16:47

Exactly. And, you know, so it's, it's a small relative increase, let's say, for, in, let's say, in a city like London, if you take, let's say, the 10% of the population with the lowest exposure

and compare them to the 10%, with the highest exposure, there will be some relative increase in disease frequency with higher exposure, but it's, it's pretty small compared to things like smoking, but everyone is essentially exposed to air pollution. You know, as we mentioned, almost everyone's exposed above the WHO guidelines and in some cases by a huge margin. And so when you when you calculate, you know, how much people are exposed to air pollution, and what is the increase in disease and disability disease and mortality from air pollution globally, it's a huge impact. And this is what, you know, the global burden of disease project really is, is very effective at showing and it's a it's an issue for outdoor air pollution and household air pollution. And, you know, the global burden of disease project has been tracking this now over many years. And I think for many people, it's quite a surprise to see air pollution up there among the top risk factors for for basically, death and disease globally.

Harry Kennard 18:13

Yeah, one thing your work, if I might say in this sort of focus or have focused a lot on India as a country, sort of specifically in terms of poor air quality, are you able to sort of speak a little bit about the specifics of what that work entails and some of the ways in which India in particular is impacted and what it is that makes that happen?

Catherine Tonne 18:35

Yeah, so, you know, as I mentioned, this particular time of year is always when air quality in India becomes a big big story, because of you know, the chain, you can get very, very high concentrations in Northern India at this time of year due to more source activity. So, stubble burning, it's also wind volley happens and also is a consequence of, you know, the specific meteorology at this time of year. But India is obviously a vast and very heterogeneous country. And you see this also in terms of the outdoor air pollution. So, there you have much higher concentrations of air pollution in the north, compared to the south. This is throughout the year. Obviously, this time of year is very special. And this has to do with population density, density of sources like coal burning fire, coal burning power plants, meteorology and barriers to dispersion like the Himalayas was so it's particularly an issue in the north. You know, the annual average concentration of PM 2.5 in Delhi as well above 100 micrograms per metre cube in in the south where I've worked, it's around, let's say 30-35. So quite a bit lower. You know, Through the chai project, which we finished a few years ago, we were working outside of the city of Hyderabad in, in the state of Telangana. And there the, the concentrations were about 35 micrograms per metre cubed. But what was interesting there is we're working in basically a rural area. And there's almost no air pollution monitoring outside of big outside of big cities. So there's this focus, often that air pollution is an urban an urban issue, outdoor air pollution. And, you know, I think in India, what you see is, is quite high air pollution concentrations in many rural areas. And that, and that's, you know, essentially what we could show with the monitoring that we did in Telangana. And this is, for many reasons, you know, fine particles are sort of regional in

many cases. So that's, and you have a lot of other sources of combustion than the vehicles that are that are influential in rural areas, particularly household sources of household energy. So India is, you know, just a fascinating place. It's an it's a very fascinating place for an air pollution epidemiologist. And what was, I think, particularly interesting, there was also some of the work that we did on not just what the air pollution levels are outside, but what do people actually breathe? What is their personal exposure to pm 2.5. And, and we looked at this in the child project by combining wearable camera data. So we were essentially trying to find out what matters more for your exposure to air pollution is, is it who you are? Is it that you're a man and woman, an older person, a younger person? Is it where you are? Or what you're doing? And we use this combination of wearable camera data, GPS tracking data and continuous personal, fine particle measurements? To try and answer that question. And, you know, what we saw for women was that their exposure was largely determined by whether they had access to LPG, or were using biomass as their main cooking fuel, how often they were cooking. And I think what was interesting for men is that it was a much more complex set of factors that that influence their exposure. So the whether or not in the household, they had access to LPG was very influential on the men's exposure. So even though they don't cook, they still get exposed, right. So it's still in the same house. But also, you see the contribution from active smoking and a lot of occupational exposures. So in thinking about, you know, what, what needs to be targeted to reduce exposure to air pollution, to improve health outcomes, you know, it's really a range of things, it's, you know, controlling sources outdoors, but also this, you know, protecting people in occupational settings. And, and obviously, the, you know, increasing access to, to LPG in India is is really a priority.

Harry Kennard 23:32

Just sort of zooming out a little bit, we're in the immediate aftermath of COP 27, when we're recording this. So things wrapped up a few days ago. I'm just wondering if you have a sense of how you see international meetings like COP 27, which, of course, you know, the CO benefits of mitigation are discussed at meetings like this, how much you see those kinds of meetings as being a driver for improving air quality, and climate change more broadly? Or whether it comes from or change comes from a different source? If you had any, any thoughts on that?

Catherine Tonne 24:11

Yeah, I mean, it's a tricky question. I mean, obviously, the big breakthrough from this last meeting was related to the loss and damages funding for developing countries, which is very relevant to help them address adaptation to climate change, but doesn't really address this issue on the mitigation side, you know, where I think we have very little progress and which is quite alarming. Yeah, I think this concept, I mean, my personal view, is that the concept of the healthcare benefits of transitioning away from let's say, fossil fuels to renewable energy, and, you know, the health the healthcare benefits are huge, but still, they don't feature that

much in the discussions. When we look at you know, many of the discussion ans in the sort of international fora, it's, it's, I think the cobenefits concept just doesn't get a lot of attention. And I think there's, you know, a lot more that needs to be done, let's say from the research and advocacy communities to just really keep, keep banging on about this, because I think it is a compelling argument. And and it's particularly compelling, because if you look at India, for example, in places like, you know, where you have high levels of air pollution, you know, exiting fossil fuels, you know, has the potential to deliver really massive health care benefits that really, you know, from lower air pollution? It's not, you know, straightforward, and I think this is some of the work that we've done in terms of looking at the the interplay between ambient air pollution and household air pollution and show that, you know, if, if you have specific strategies for reaching, let's say, a two degree or 1.5 degree target, that that could lead to increases in prices of clean cooking fuel, like LPG and some sort of backsliding away from LPG to biomass, which is essentially free for many people. So it's important in thinking about how it What's that pathway look like to to basically achieving the climate change mitigation goals and the important health care benefits of lower air pollution to make to make sure that there isn't some on on sort of negative consequence or trade off there. And, you know, some of the work that we did was showing that, you know, that could be addressed in a sort of more joined up policy that, that combined the climate change mitigation, and, you know, increasing access to clean cooking fuel, through subsidies, or something like this. But I think, you know, these are really compelling arguments, because the, the health benefits are immediate, and they happen in the place where the emission reductions take place. And that's obviously not the case with greenhouse gases where the benefit is, you know, experienced globally and much farther out into the future. So I'm, I'm still looking for, you know, the way to get more engagement on this concept of healthcare benefits in some of these international forums. And, you know, to just because I think it could be a compelling argument for people that are, you know, maybe more motivated by, you know, what's in this for me, because it does really deliver benefits. Yeah. Let's say the communities where the emission reductions take place.

Harry Kennard 28:06

Well, that's fantastic. I mean, that's a good advertisement for this podcast, perhaps in terms of its focus on mitigation co benefits. Well, Catherine, that was, that was a fantastic talk through everything there. Really appreciate you coming on. And thanks very much for taking the time.

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